International Journal of Educational Policy Research and Review Vol.8 (6), pp. 232-235 November, 2021
Available online at https://www.journalissues.org/IJEPRR/
https://doi.org/10.15739/IJEPRR.21.026

ISSN 2360-7076

Review

The human brain: Search for natural intelligence

Received 20 August, 2021 Revised 9 September, 2021 Accepted 14 September, 2021 Published 3 November, 2021

Kamal I. Al-Malah

Chemical Engineering, Higher Colleges of Technology, Ruwais, Abu-Dhabi, UAE.

Author's E-mail:
kalmalah@hct.ac.ae
k.almalah@gmail.com

Tel: +971-502286961

As we all live in the digital era, characterized by a continuous change in terms of content of and volume of accessible knowledge, it is time to reflect on and ponder over the overwhelming, multidisciplinary knowledge and the domain-specific knowledge. It is time to search for natural intelligence. The rhythm of knowledge acquisition does not cope with the mushroom-type of knowledge explosion. Explaining how powerful the human brain is in terms of its memory capacity, educators can nurture on this privilege and utilize it to the maximum in terms of building the virtual being either for a specific domain or for a multidisciplinary type of domain such a beginner can be prepared from zero, ground level up to a fully functional expert in the specified domain. Intuitively, this also requires a fully functional and well-prepared instructor to disseminate at least the skeletal knowledge so that the learner can later wrap the skeleton with the additional beef of knowledge to end up with a wholesome and healthy wellbeing.

Keywords: Human brain, neurons, digital era, natural intelligence, petabyte, memory diversity, interdisciplinary, multidisciplinary, skeletal knowledge

INTRODUCTION

I begin by emphasising the importance of the brain and how wonderful it is as a tool and container for knowledge/information acquisition, processing, storage, and dissemination in order to help the reader and researcher accept the idea of preparing a teacher with versatile, intra-disciplinary, and skeletal knowledge within his/her domain knowledge.

We are living in the digital era, which is characterised primarily by artificial intelligence, deep learning, machine learning, deep fake, image analysis, pattern recognition, and massive (soon to be petantic) data ware mining. The volume of accessible digital data is so large that super macro stations are required to deal with it in the form of storage, retrieval, analysis, and presentation. GAFAM, which stands for Google, Apple, Facebook, Amazon, and Microsoft, is the largest owner in this regard.

Consequently, we should work in parallel to enhance what I call the build-in, natural intelligence. Let us zoom in down to the functional structure of the brain to see how it functions and present some numbers regarding its intellectual wonderful capacity.

Figure 1 shows a small sketch of the building block of our brain, the neuron. As shown on the left side, the neuron is structurally made of the pre-synaptic "sending" cell, the axon, the axon terminals, the synapse, the dendrites, and the post-synaptic "receiving" cell. The synapse zone is magnified (right side) to show that it is made of the pre-synaptic axonic terminal, the synaptic cleft, and the post-synaptic dendritic membrane. It acts like a bridge between a pre-synaptic and post-synaptic neuron. The direction of biochemical information is downward from a pre-synaptic passing through the axon, entering the synapse (twilight) zone, and finally arriving at the post-synaptic neuron through its receiving dendrites. The pre-synaptic neuron sends a message to post-synaptic neuron by secretion of biochemical substances, known as neurotransmitters. It is important to note that within the synapse zone, the two neurons are not physically connected to one another; rather, they communicate via neurotransmitters (Mandira, 2016). This neuro-transmission process will create or trigger the action potential in the post-synaptic neuron, in response to the received signal which has already arrived

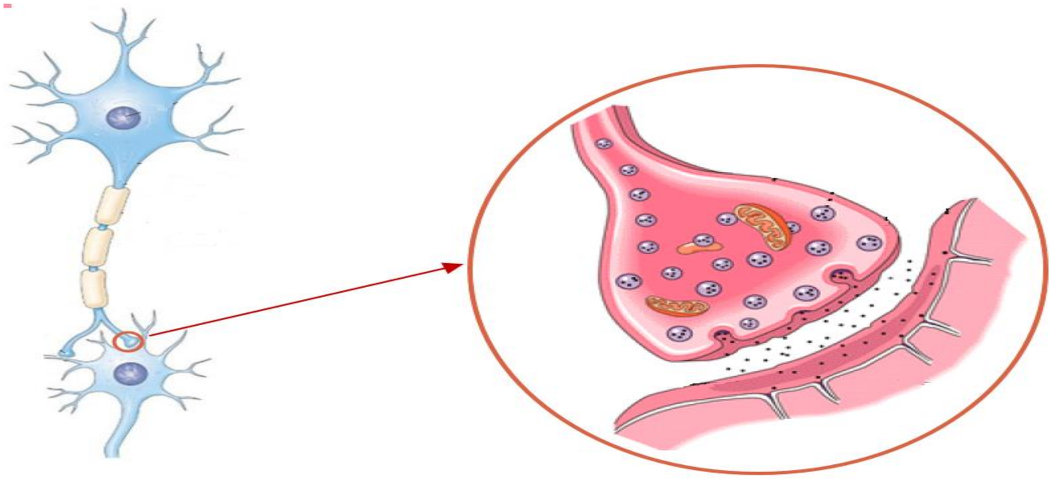

Figure 1: A pre-synaptic and post-synaptic neuron with middle zone, called synapse, being magnified

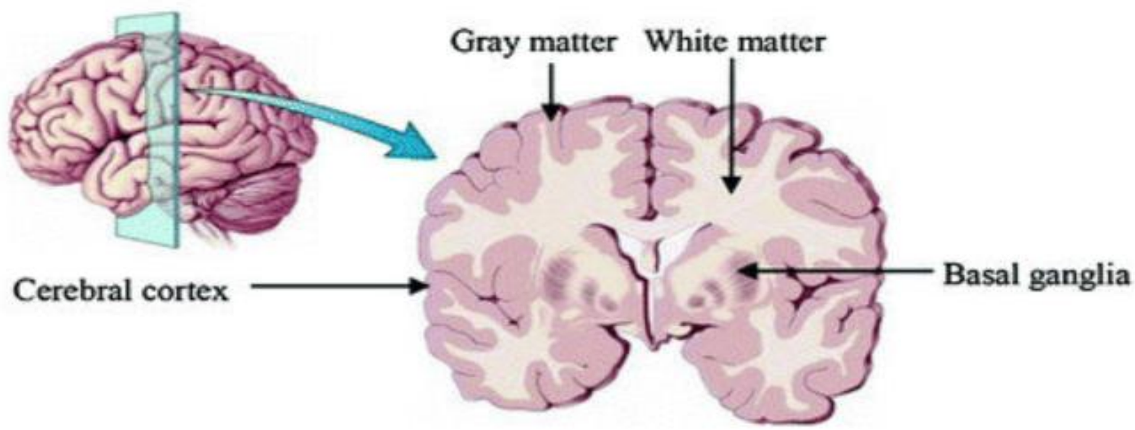

Figure 2: The cerebral cortex of the brain (the gray matter)

at the pre-synaptic dendrites of the first cell (top left).

Figure 2 shows a sketch of the cerebral cortex, the gray matter, of our brain (Visutsak P and Li, 2016). The cerebral cortex (mantle) is the outermost, wrinkly layer of tightly packed neural tissue of the brain. It is also responsible for higher thinking and information processing, including received information, issuing from the five senses, decision making, and speech. "The cortex is split into four different lobes, the frontal, parietal, temporal, and occipital, which are each liable for processing differing types of sensory information" (Cerebral Cortex, 2019).

The cerebral cortex alone has 125 trillion synapses. In another study, it was reported that 1 synapse can store 4.7 bits of information (What is the Memory Capacity of a Human Brain, 2021). *This storage capacity amounts to*

$$125 \times 10^{12} synapse \times \frac{4.7\ bit}{synapse} \times \frac{1\ byte}{8\ bit} \times \frac{1\ terabyte\ (TB)}{1.099 \times 10^{12}\ byte} = 66.8\ TB$$

Notice that 1 TB=1024 GB.

According to Reber (2010) the memory capacity of the human brain was reported to have the equivalent of 2.5 petabytes of memory capacity. A "petabyte" means 1024 terabytes or 1,000,000 gigabytes, therefore the average adult human brain can store the equivalent of 2.5 million gigabytes digital memory. By comparison, Yahoo's 2.0 petabyte computational center, capable of processing 24 billion "events" a day, is a full 20 percent smaller than the capacity of a single human brain (What is the Memory Capacity of a Human Brain, 2021). Or, a if human's brain works like a digital video recorder in a television, 2.5 petabytes will be enough to hold three million hours of TV shows. One must leave the TV running continuously for quite 300 years to spend all that storage (Reber, 2010).

Interlandi (2016) indicated that a study had found that the brain's information storage capacity may be around a quadrillion (1×10^{15}) bytes. A human brain is made up of about 100 billion neurons, and that each neuron networks with additional 1,000 neuronal connections, adding up to some 100 trillion in total. In the indicated study, a total of 26 unique synapse sizes were plugged in the proposed algorithm. A greater number of synapse sizes means more

capacity for storing information, which during this case translated into a 10-fold greater storage capacity within the rat hippocampus than the previous three-size (low, medium, large synapse size) model had indicated. Just to imagine how large a petabyte-size database is, consider the following modern applications (Dube, 2019):

- Google processes over 24 petabytes of information every day.
- Mobile phone networks transmit over 20 petabytes to and from users every day.
- The Blue Waters supercomputer has over 500 petabytes of tape storage.
- The United States Library of Congress contains over 7 petabytes of digital data in its archives.
- World of Warcraft servers require over 1.5 petabytes of storage to run its online game.

Obviously, it will be very unlikely that we will reach the state where a person receives an internal warning message from his/her brain (soft drive) that it is 100 % full, although, in principle, there must be a physical storage/memory limit.

One point worth-mentioning here is that the brain acts as a medium and processor for both long-term and short-term memory. To some extent, the long-term and large-size memory is analogous to the hard drive of a computer/mobile and the short-term and small-size memory is analogous to the random-access memory of a computer or mobile. The latter type is also denoted as working memory (Burmester, 2017).

The working memory is volatile (i.e., short-living and small in size). On the other hand, the "permanent" memory is long-living and extra-large in size. Keep in mind both types of memory are dynamic by nature, which means that the data type (or content) and the amount of data, as well, do change with time and are vulnerable to brain's biochemical processes and events, in the form of editing, replacing, appending, saving, and deletion. Moreover, the interplay between the two types of memory is subject to the frequency of remembrance or rehearsal process and to one's persistence to keep even tiny details as vivid in memory. Neuroscience makes a clear distinction between the two types of memory. The working memory is related to temporary activation of neurons in the brain. In contrast, the long-term memory is thought to be related to physical changes to neurons and their connections (Burmester, 2017).

For us as educators and working in the academia, we should pay more attention on how to maximize the performance of and assure a frequent maintenance for our brain. Although this is not the topic of this article, it is worth mentioning that the human brain suffers from many types of disorder, yet alphabetically ordered, addiction, Alzheimer's disease, amyotrophic lateral sclerosis (ALS), anxiety, autism, chronic pain, depression, epilepsy, migraine, multiple sclerosis, Parkinson's disease, schizophrenia, sleeping disorder, stroke, tinnitus, and traumatic brain injury (Boyden, 2011).

Here, I propose the following arguments to be discussed among educators and give it an initial impetus and sustained momentum.

1. A compulsory course on human brain for our students at a high school level, including its nature, capacity, data storage, data processing, memory retrieval and rehearsal, functional structures, brain/mental disorders, the wholesome food needed for a healthy and fully functional brain, food-based brain damage or malfunction, and addiction. Addiction includes all types, like chemical, electronic games, and habits. Interestingly enough, people know more about what food makes a good body and what food makes the other head healthy, although the most important sexual organ in men is brain. If the learner knows what power he/she holds, it will grant the candidate the perpetual internal combustion machine or an everlasting burning desire to keep one moving on and on (This reminds me here with a commercial ad of Duracell battery saying no battery looks like it or ever lasts like it).

2. We should revise educational (cognitive) methods of learning to include topics that will answer the following legitimate questions:

a) How can we maximize our intellectual power, given that each one of us can have the chance to possess a peta-byte relational (context-base structured) database?

b) How can we minimize the normal tendency to forget (oblivescence versus reminiscence)? In other words, how can we maximize the process of retaining information/knowledge for a lifelong period?

c) Why do we keep some information, knowledge, or events in memory since practically the first day we became aware of things around us?

d) How can we speed up the process of learning itself?

e) How can we end up with shortcut methods to boost our mental being to handle giant data and "complex" mathematical operations?

f) How can we speed up the process of data recall or retrieval (cache memory)?

g) How can we make an initially, unfavored topic to be eventually a favored topic for the beginning learner?

h) Why does a person love some colors or flavors of knowledge whereas he/she hates others?

I strongly believe that God created people equally in their rights to acquire knowledge but differently in their ways and rates of acquiring the knowledge (i.e., eventually reasoning). The difference between one person and another has nothing to deal with "non-human" factors, like color, race, gender, etc. Of a primary concern is how people develop their mental or intellectual beings. We as human beings are diversified by nature in terms of learning (possessing) capacity and pace or later in terms of dissemination methods and capability to gage one's learners.

Every person, whether he/she is a learner or a teacher, is a stand-alone entity and life-long path pursued by the person him/herself. Our capacity of helping others simply lies in the fact that we must be humble enough to listen to others' problems as far as learning barriers are concerned. This tacitly requires starting up with a small-size class and

assign the instructor to handle such a batch of students from A to Z in each field or curriculum. The contact time and intimacy between the instructor and his/her students will be practically unlimited and eventually replicates of the instructor will be created out but this time with better attributes and qualities than those of their predecessor (instructor). With such a super-giant (petabyte), God-granted brain capacity, both the instructor and students can be trained, prepared, and tuned-up to easily swallow and digest the skeletal, domain knowledge of any discipline you may think of. This will make our future student to be at least a specialized, viable encyclopedia. Moreover, the expansion in one's knowledge can be made to include what we call today interdisciplinary and multidisciplinary interacting domains of knowledge. We should shoot for a complete, concise, integrated, and highly interacting superhuman brain.

CONCLUSION

In conclusion, focus should be made on how to speed up and maximize one's brain in terms of gaining knowledge and utilizing God-granted marvelous super-giant brain, as explained above.

The approach, or paradigm is not restricted to one color or flavor of knowledge. It is applicable for all disciplines of knowledge. The problem with this approach is simply teachers, not students, are not willing to exert an extra effort to prepare themselves toward what I describe as the "perfect" instructor.

This approach, or practice had been done in the past for centuries where the instructor is expected to act as an encyclopedia for his/her domain knowledge; however, as a result of the mushroom explosion in knowledge it is time put things in a context or frame of curriculum to serve the idea of getting a degree or a benchmark of recognition and appreciation, along the long road of a human marathon of a life-long learning experiment.

Data availability

Data are included in this manuscript. No external data.

Funding statement

Funding is not applicable. No conflict of interest.

REFERENCES

Mandira P (2016). In a neural pathway, what is a synapse? Accessed January 20, 2021. https://socratic.org/questions/in-a-neural-pathway-what-is-a-synapse#281099.

Visutsak P, Li Y (2016). Autism spectrum disorder: Brain images and Registration. International Conference on Health Information Science.

Cerebral Cortex. Created September 24 (2019). Accessed January 20, 2021. https://brainmadesimple.com/cerebral-cortex-and-lobes-of-the-brain.

What is the Memory Capacity of a Human Brain? (2021). https://www.cnsnevada.com/what-is-the-memory-capacity-of-a-human-brain/. Accessed January 20, 2021.

Reber P (2010). What Is the Memory Capacity of the Human Brain? Accessed January 20, 2021. https://www.scientificamerican.com/article/what-is-the-memory-capacity/

Interlandi J (2016). New Estimate Boosts the Human Brain's Memory Capacity 10-Fold. Accessed January 20, 2021. https://www.scientificamerican.com/article/new-estimate-boosts-the-human-brain-s-memory-capacity-10-fold/.

Dube R (2019). Memory Sizes: Gigabytes, Terabytes, and Petabytes Explained. Twitter: @rdube. Posted in: Networking. Accessed January 20, 2021. https://helpdeskgeek.com/networking/memory-sizes-gigabytes-terabytes-and-petabytes-explained/.

Burmester A (2017). Working Memory: How You Keep Things "In Mind" Over theShort Term. Accessed January 20, 2021. https://www.scientificamerican.com/article/working-memory-how-you-keep-things-ldquo-in-mind-rdquo-over-the-short-term/.

Boyden E (2011). A light switch for neurons. Accessed January 20, 2021. https://www.ted.com/talks/ed_boyden_a_light_switch_for_neurons?utm_campaign=tedspread&utm_medium=referral&utm_source=tedcomshare.